Global Ring Network for Advanced Applications Development (GLORIAD)



ONT2 Workshop September 13, 2005

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Animation by Korea Institute of Science and Technical Information



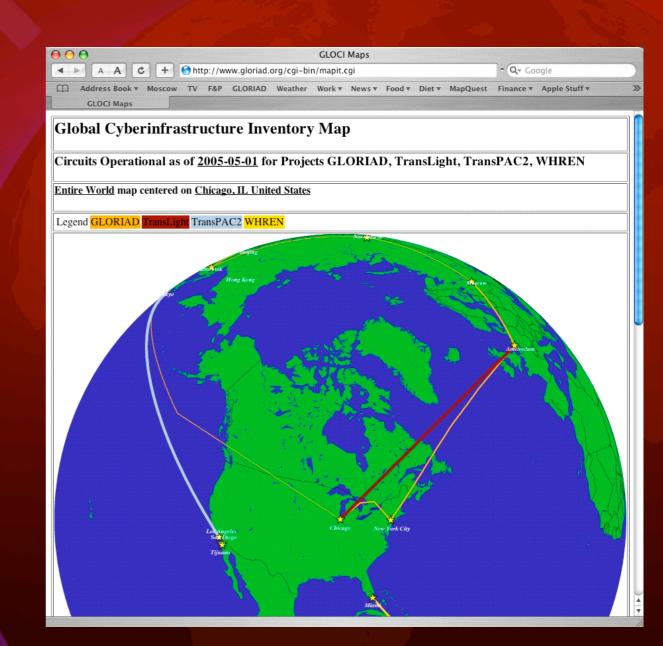
NSF IRNC Cooperative Agreement University of Tennessee \$4.2M/5 years, began January 1, 2005

http://www.gloriad.org/

VSNL

NSF International Research Network Connections Program (IRNC)

- 5 yr \$25M program to help advance international R&E network connections
- **January 1, 2005 December 31, 2009**
 - GLORIAD US-Russia-China-Korea-Netherlands-Canada
 - TransLight/Europe US-Europe
 - TransLight/PacificWave connections for Asia/Pacific
 - TransPAC2 US-Japan/Asia
 - **WHREN-LILA US-Latin America**
- Follow-on to NSF HPIIS Program (1998-2004) (Cumulative Funding from NSF for GLORIAD team: \$9.5M)



GLORIAD



- An advanced S&E network "ring" around the northern hemisphere linking scholars, scientists, educators in Russia, US, China, Korea, Netherlands, Canada and others with specialized network services, co-funded by all international partners
 - 155/622 Mbps today + 10G HK KR SEA, 10 Gbps ring in early 2007, Nx10G in 2008
 - Hybrid circuit-(L1/L2) and packetswitched service (L3)
- Program to Develop/Deploy
 Advanced Cyberinfrastructure
 between partnering countries (and
 others) as effort to expand science,
 education and cultural cooperation
 and exchange
- A participant in/contributor to GLIF

Why?

- Leverage jointly developed/funded/operated S&E network to expand S&E cooperation between partnering countries
- To support specific S&E applications not supported well by commodity or traditional R&E networks
- To enable communities to build their own specialized networks and for short durations of time
- To provide a test-bed for advanced network research
- To encourage compatible/complementary infrastructure development in closer step

Special Applications

- Need to move a terabyte of data quickly
- Need guaranteed 1.5 Gbps for high-definition uncompressed video for two hour session
- Need carefully managed/controlled "jitter" for steering a visualization (such as a "fly-through" application)
- Need a privately managed, secure network linking partners distributed around the globe
- Need to tie together large-scale computing resources with dedicated network services

Why?



Rita Colwell, former NSF Director, Dec. 2003 press release

"As part of the international community of science, we share common concerns that reach across national borders. As we all aim to strengthen our nations' capabilities in research, we also aim to contribute to the cumulative knowledge that lifts the prospects of people everywhere.

This new network serves as both a physical and symbolic reminder of our common goal of solving problems and building a world of peace and prosperity."

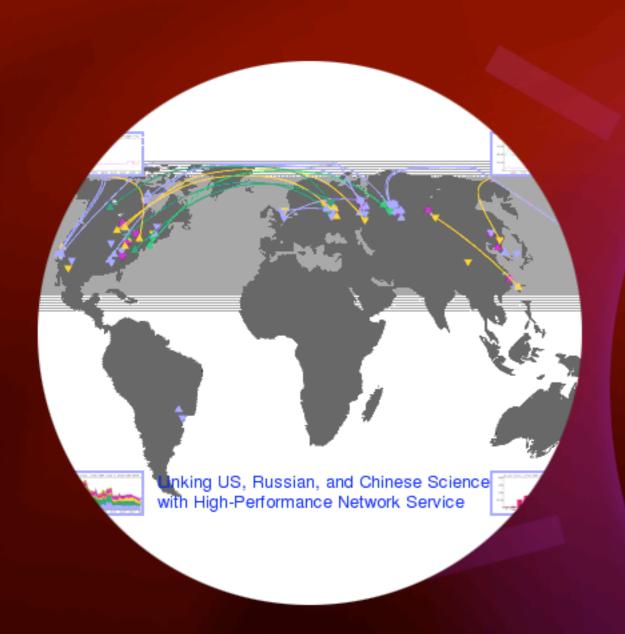
Dec. 21, 2003, NSF Press Release

GLORIAD History



- Early beginnings in 1994 with F&P, 1997 with ClVnet, 1999 with MIRnet, 2001 with NaukaNet
- Beijing agreement signed by Velikhov, Jiang, Cole in December 2002 to develop "Little GLORIAD"
- Little GLORIAD became operational on January 9, 2004 (Tyco OC3 links Chicago-Moscow, Chicago-Beijing); launched in Beijing January 12, 2004
- Moscow-Beijing OC3 (across Russia-China border) became operational in July, 2004. Ring complete.
- Proposal submitted to NSF IRNC program June, 2004
- Meeting hosted by Netherlands partners in September, 2004 US, Russian, Chinese, Korean, European partners attend
- First meeting with Canadian partners in Nov, 2004
- HKLight launched by CAS/CNIC November 23, 2004
- NSF Grant funded December 2004, "Big GLORIAD" program begins in US on January 1, 2005
- 10G Hong Kong-Daejon-Seattle Circuit funded/completed by Korean partners

GLORIAD TODAY



GLORIAD Circuits Today

- 622 Mbps Moscow-AMS-NYC
- 1 GbE NYC-Chicago (CANARIE)
- 155 Mbps Chicago-China Hong Kong
 - 2.5 Gbps China Hong Kong-Beijing
- 2.5 Gbps AMS-Moscow
- 155 Mbps Beijing-Khabarovsk-Moscow
- 10 Gbps China Hong Kong-Daejon-Seattle
- 10 Gbps Seattle-Chicago-NYC (via CANARIE contribution to GLORIAD/GLIF)
- This year: 2.5 Gbps US-China link in October, 2005, 10 Gbps US-AMS in January, 2006

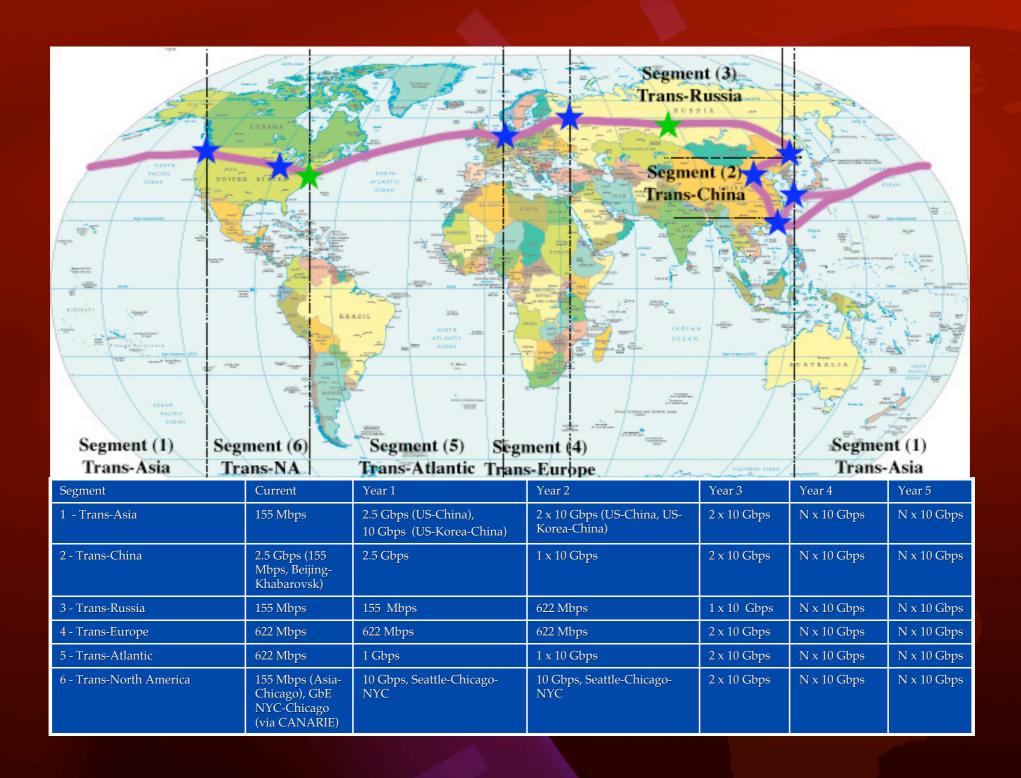
Grand Opening of "Big GLORIAD" September 5-6, 2005, Seoul, Korea



- opening of first 10Gbps GLORIAD circuits China HK Daejeon Korea Seattle
- Funded by Korean Ministry of Science (MOST)
- Project Leadership by KISTI,
 YoungHwa Cho, Jysoo Lee, Ok-Hwan
 Byeon
- Not only 60x capacity of original "Little GLORIAD" circuits but first "hybrid" network portion of GLORIAD
- New six-party agreement signed: US, Russia, China, Korea, Netherlands, Canada
- KISTI Unveiled first GLORIAD movie

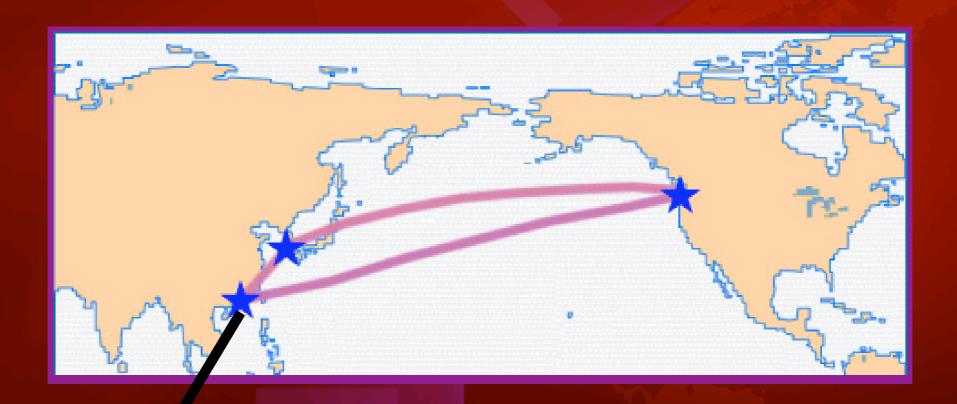
The GLORIAD Network Topology

Current, Years 1-5



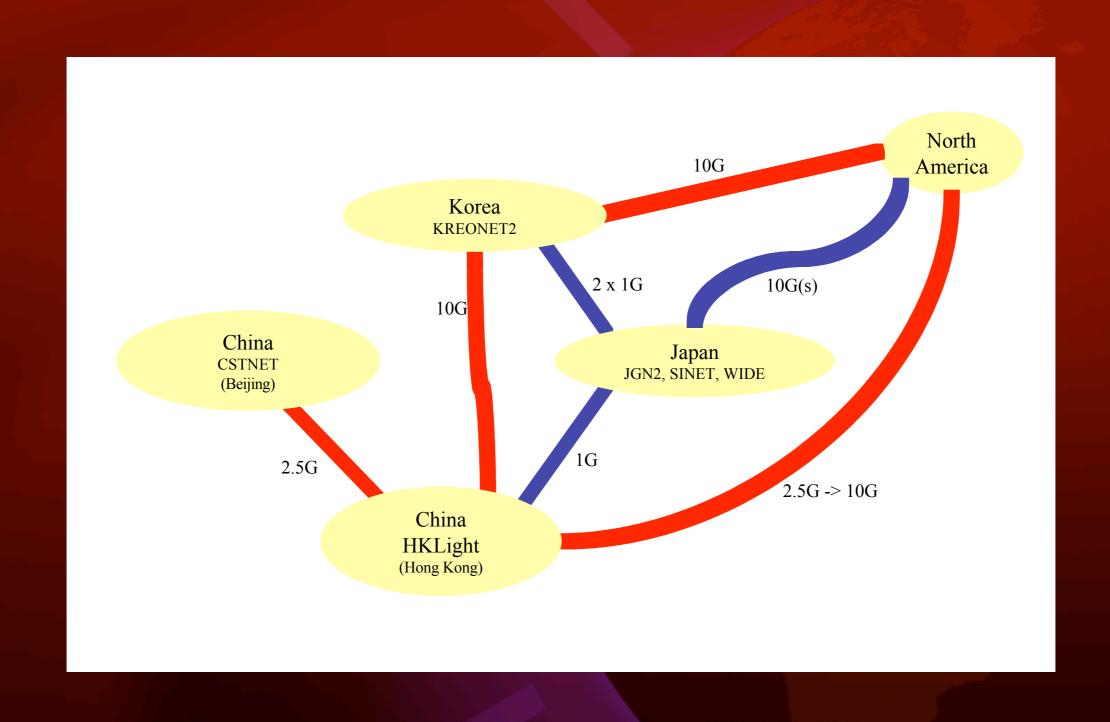
Trans-Pacific Portion (Segment 1)

(illustrating Hong-Kong-Seattle and Hong-Kong-Pusan-Seattle paths)

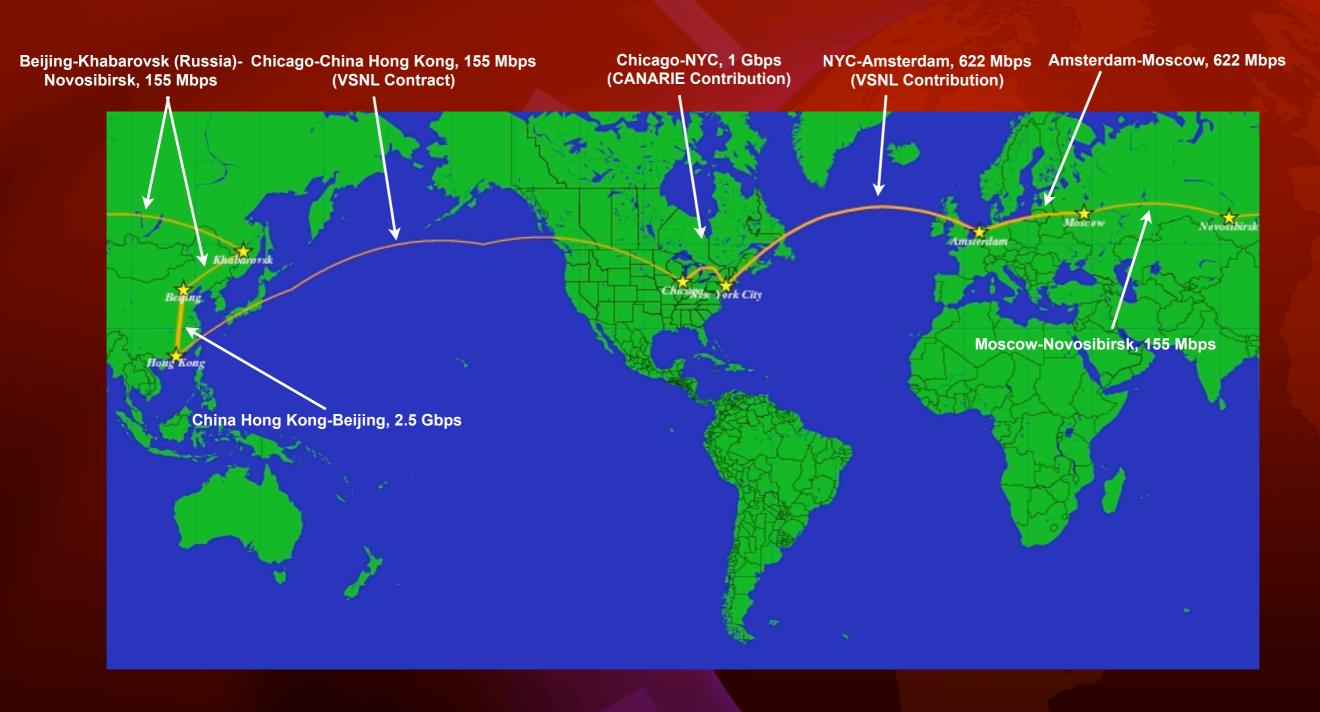


Hong Kong Light (HKLight) Open Exchange Point Other exchange points include Starlight (Chicago), Pacific Wave (Seattle), Netherlight (Amsterdam), RussiaLight (Moscow)

China-Korea Links for North Asia



GLORIAD Network On 6/7/2005



GLORIAD Network Date: 8/16/2005



GLORIAD Network Date: 3/1/2006



GLORIAD Network Date: 3/1/2007



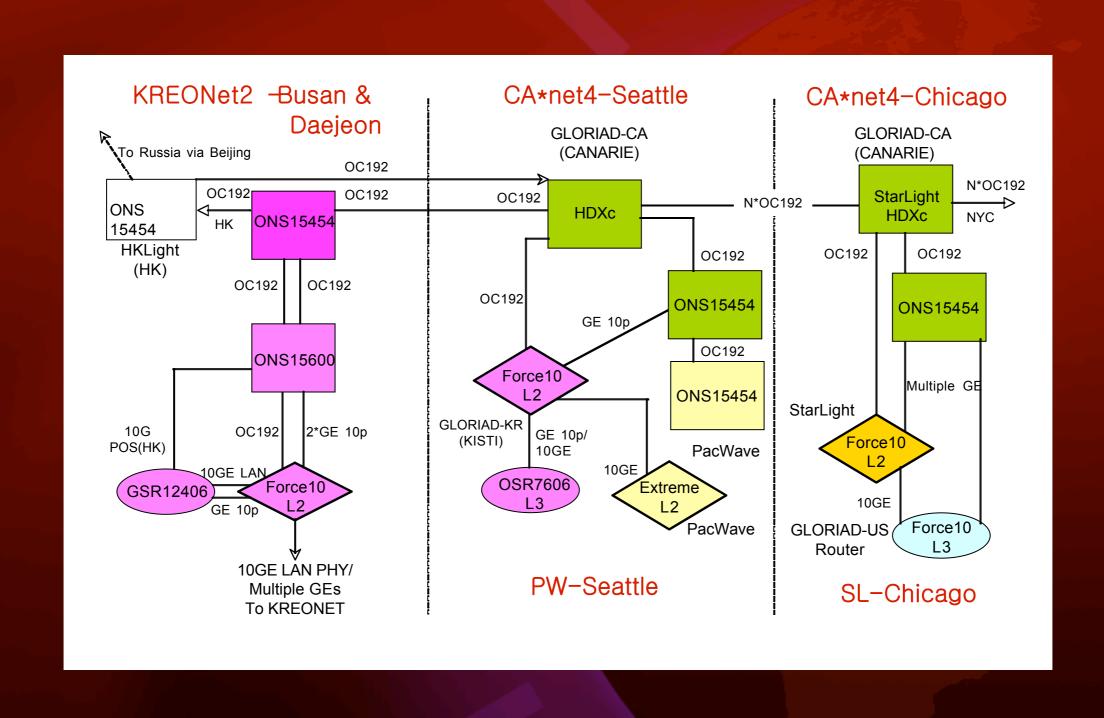
Architecture Motivation

- General S&E Applications needs met by "best effort" routed infrastructure (but minimize congestion/packet loss)
- Specialized Applications requiring high capacity, low-latency and/or controlled jitter (i.e., dedicated end-to-end circuits)
- Network research/experimentation testbed
- Backup/protection services for partnering S&E networks

Network Design

- Using MSPP devices (i.e., Ciena CoreDirector, Cisco ONS 15454, Nortel HDX, etc.), provide L1 infrastructure
- Instrument with UCLP to enable user community (and applications) to dynamically provision their own circuits across the core (and end-to-end where possible)
- Use N x GbE for layer-3 routed infrastructure (GLORIAD is in process of receiving its own AS number)
- Take advantage of ring topology for network reliability and for network experimentation
- Big emphasis on monitoring: (1) utilization, (2) performance, (3) security

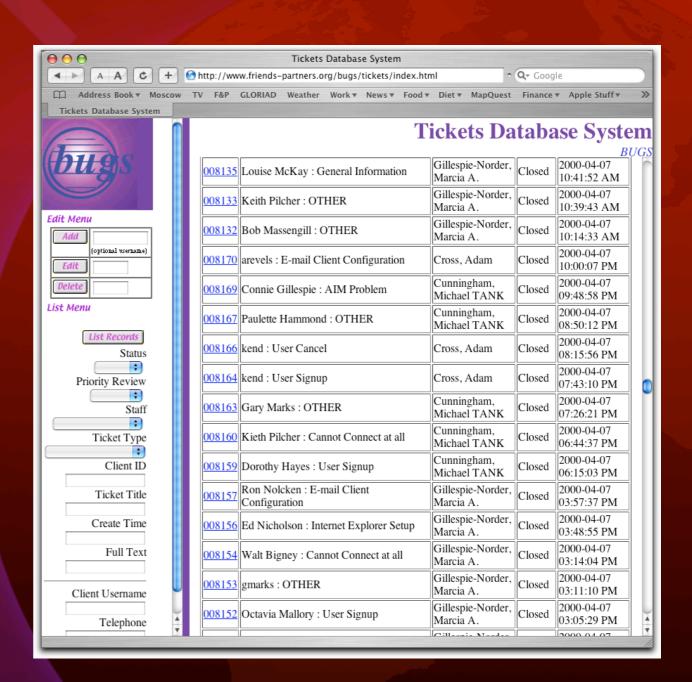
10G Connectivity for Asian part of GLORIAD



Network Operations

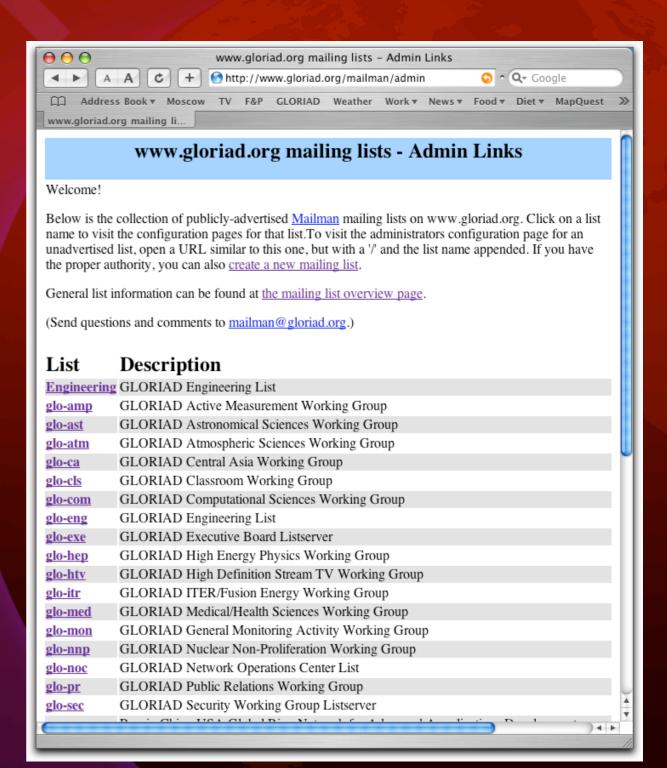
Developing "distributed NOC"

Deploying own trouble ticketing system (integrated with monitoring sub-systems)



Working Groups / Governance

Executive Board 30+ Working Groups **Dealing with: Networking Issues Monitoring/Security** ssues **Research Disciplines Project Management Education/Outreach Programs**



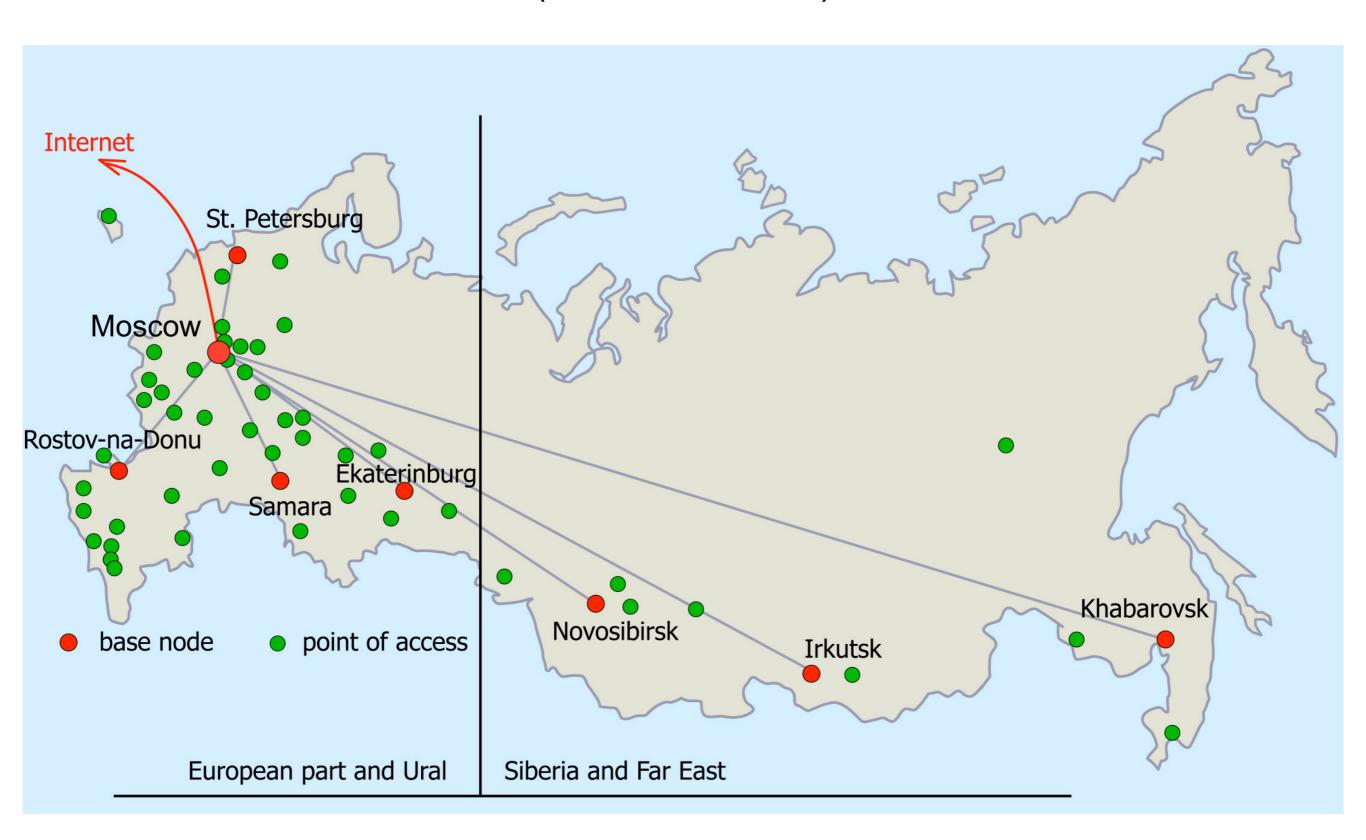
Who in Russia?



- Acad. Evgeny Velikhov, President, Kurchatov Institute, Academician-Secretary, Russian Academy of Sciences
- Ministry of Science & Education, Agency of Communications, Agency of Atomic Energy, Moscow State University, Joint Supercomputing Center
- Russian Backbone Network (RBNet)

RBNet links

(General scheme)



RBNet connectivity with regional R&E networks (European part and Ural)



RBNet connectivity with regional R&E networks (Siberia and Far East) Omsk Tomsk Krasnojarsk Novosibirsk Kemerovo Khabarovsk Blagoveshensk Irkutsk Ulan-Ude Barnaul **RBNet** core base node Vladivostok Links to regional networks access point



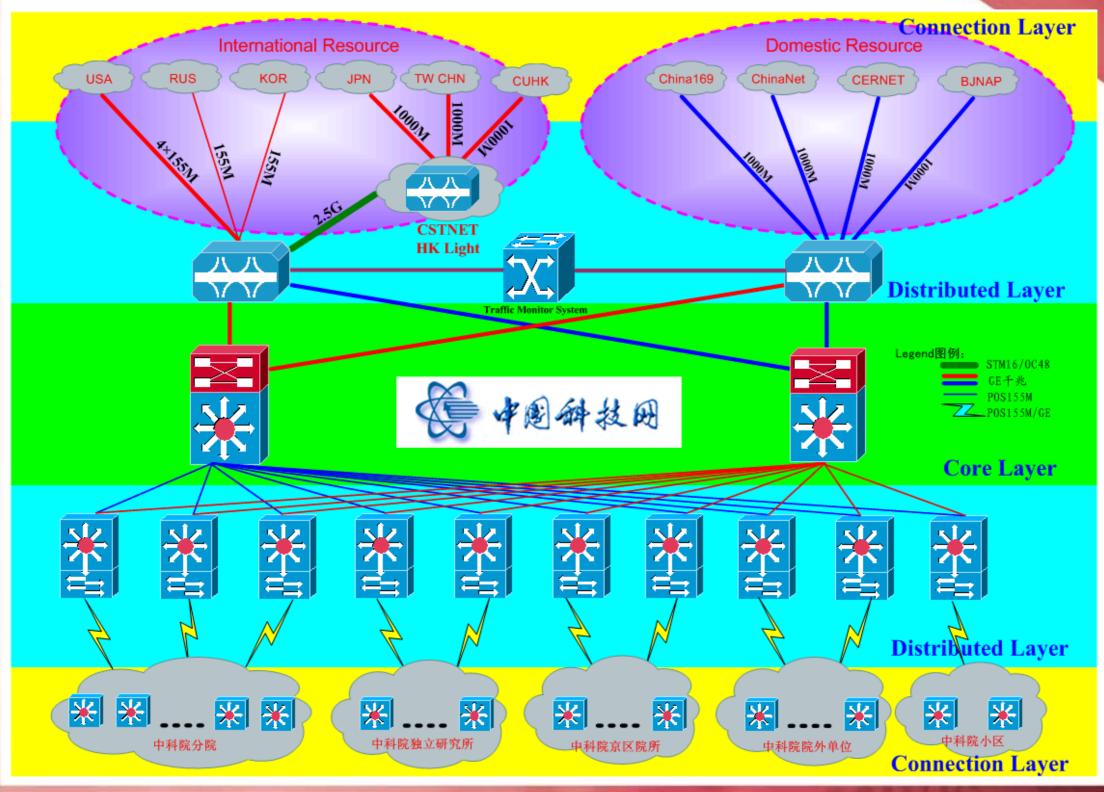




- President, Chinese Academy of Sciences, Telecomm/IT Developer (signatory of first GLORIAD agreement)
- Dr. Baoping Yan, Director, Computer Network Information Center (CNIC), Chinese Academy of Sciences. Directs all GLORIAD activities in China
- Dr. Jun Li, Deputy Director, CNIC, Director, China Science & Technology Network (CSTnet)

CSTNET Core Infrastructure





China Hong Kong Internet Open Exchange Point

- Nov 23, 2004, the Beijing-China Hong Kong section of the "China-US-Russia Global Ring Network for Advanced Applications Development (GLORIAD)" has been upgraded to 2.5G
- On the same day, the Chinese Academy of Sciences formally announced a plan to establish the next generation light wave "China Hong Kong Internet Open Exchange Point-HK Light"
- HK Light is the first Open Exchange Point in Asia
- HK Light will serve as a venue with high-speed(proposed to be 10G) networks coming from Japan, South Korea and China Taipei etc. Other States as Singapore, India and Australia are also very much interested in it.



HK Light Press Conference

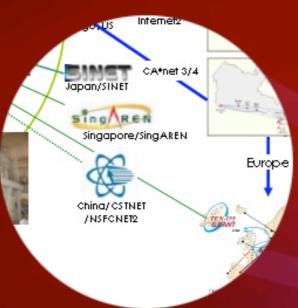


中國科學院建立香港開放交換接點 Hong Kong OEP (HK Light)
se Academy of Sciences establishes HK Open Exchange Point - HK OEP (HK Light)
新聞發佈會 Press Conference
23/11/2004





Who in Korea?



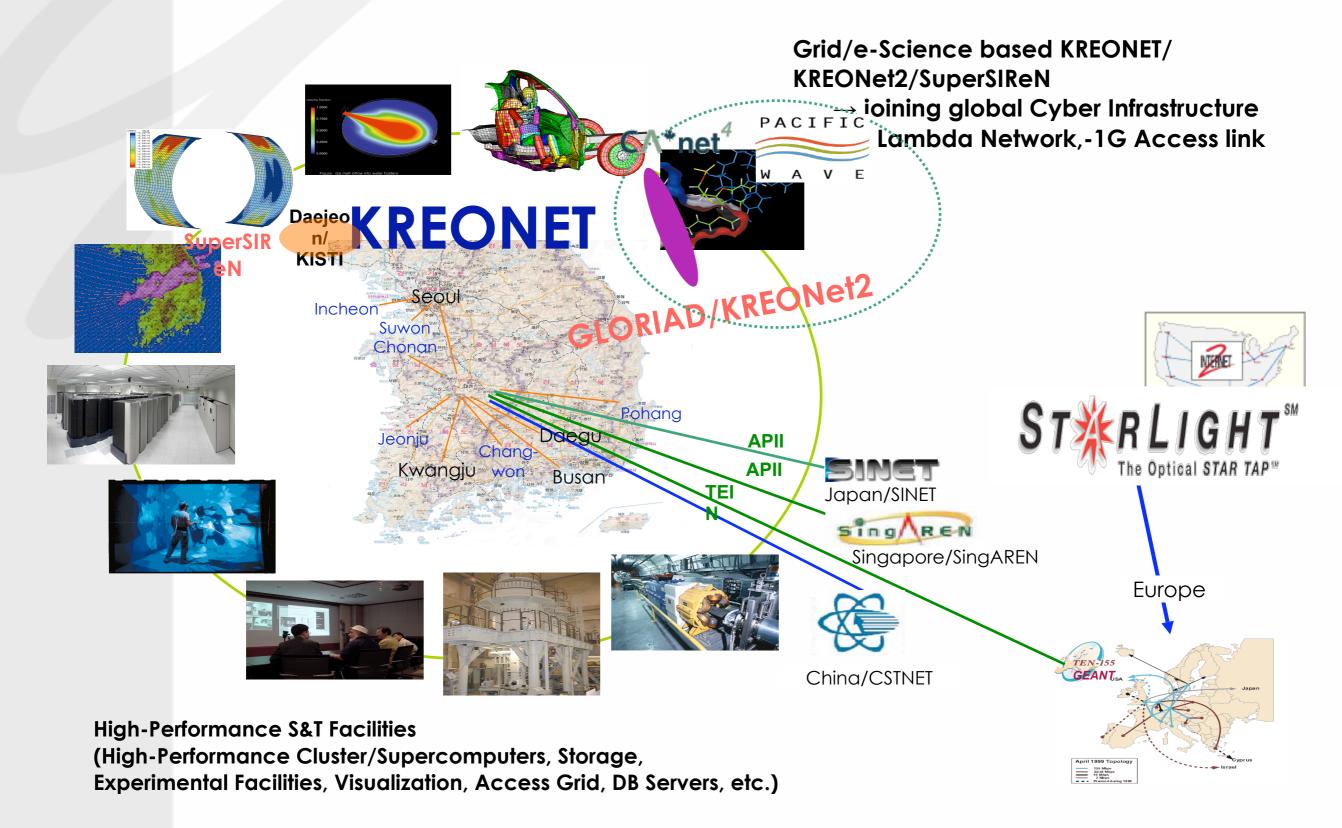
- Dr. Young-Hwa Cho, Director, Korea Institute of Science and Technology Information (KISTI)
- Dr. Jysoo Lee, Director,
 Supercomputing Center, KISTI
- Dr. Ok-Hwan Byeon, Dongkyun Kim, Minsun Lee, KREONet2, KISTI
- Korea Research Education Network (KREONet)

KREONET

- **Korea Research Environment Open NETwork**
 - National high-performance science & research network in Korea
 - About 200 members: Universities, National Research Labs, government organizations, etc.
 - High-capacity access network(1Gbps~10Gbps): 30 members
 - Nation-wide optical gigabit backbone network
 - 12 GigaPoPs in 11 regions (~10Gbps)
 - GLORIAD/KREONet2
 - International R&E network based on KREONET
 - Korea-US: 10Gbps
 - Korea-China (CSTNet/CNIC): 10Gbps
 - KR-JP, KR-SG, KR-EU (via APII, TEIN) : ~2Gbps
 - Advanced network engineering
 - IPv6, QoS, Multicast, Traffic Measurement, Security, etc.
 - Nation-wide 6KREONET and Mbone
 - Supporting advanced applications : e-Science and Grid



GLORIAD/KREONet2



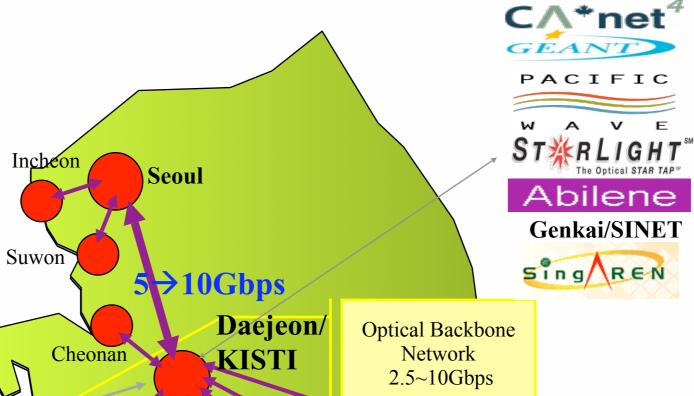
Backbone Networks

Supercomputing Facilities IBM (4,236 Gflops) Service

- 1BM (4,230 Gliops) Service
- NEC (240 Gflops) ServiceHP SMP (115Gflops) Service
- TeraCluster (221.6Gflops) service

SuperSIReN

- SeeMore (CAVE)
- Access Grid



Daegu

Gbps

Busan

KREONET

- 11 regions, 12 GigaPoPs
- 24 x 7 Operation Services
- Optical 2.5~10Gbps Backbone Network
- SONET/SDH, GigE, ATM

SuperSIReN

10→40Gbps

Jeonju

Kwangju

- Optical 10Gbps Backbone
- High Speed Wireless 1.25Gbps
- Next Generation Application Support
- Collaboration Environment Support
- 7 Academic Research Institutes

International Link(with GLORIAD-KREONet2/APII/TEIN)

- US(STAR TAP) : 1.2Gbps -> 10Gbps
- Japan (Hyunhai/Genkai): 1Gbps
- TEIN (Geant): 155Mbps

Pohang

• Singapore (SingAREN) : 17Mbps



M Gbps

Changwon

Who in Netherlands?



- Kees Neggers, Executive Director, SURFnet, Amsterdam, The Netherlands
- Erik-Jan Bos, Chief Network Engineer, SURFnet, Amsterdam, The Netherlands
- SURFnet, Netherlight Network
- SURFnet providing space and transit for GLORIAD and has been key contributor to architecture for GLORIAD

Who in Canada?



- Bill St. Arnaud, Senior Director, Advanced Networks, CANARIE
- Rene' Hatem, Thomas Tam, Chief network engineers, CANARIE
- CANARIE
- enabled circuits across North

 America for GLORIAD and GLIF
- CANARIE Providing L1 equipment for GLORIAD and GLIF

Who in USA



Oak Ridge National Laboratory

- Greg Cole and Natasha Bulashova, Research Director/Research Scientist, UT-ORNL Joint Institute for Computational Sciences, PI/Co-PI, NSF GLORIAD Agreement
- Anita Colliate Howard (Research Assoc.), John Lankford (Network Architect/Engineer), Lyn Prowse-Bishop (Exec. Asst), 2 REU students (coming), Ana Preston, Predrag
- Sponsor: National Science Foundation (~\$9.5M since 1998), Other sponsors of US-Russia work: NATO, Sun Microsystems, US State Department, Ford Foundation, Eurasia Foundation, US AID
- Many other partners: Harvey Newman (Chief Science Advisor) (~ 40 other scientists/ educators/others on advisory groups), Starlight, Pacific Wave, others
- Networks: National Lambda Rail, ESnet, NASA R&E Networks, Internet2/Abilene (peering), Federal Networks, etc.
- Also, important contributor/participant in GLIF

Who Ties it Together?



Global Networks):
Trans-Atlantic and
Trans-Pacific Provider
(with FLAG); is important
service provider and
research partner since
the beginning of
GLORIAD

Russia: RosTelecomm

China: China Netcom

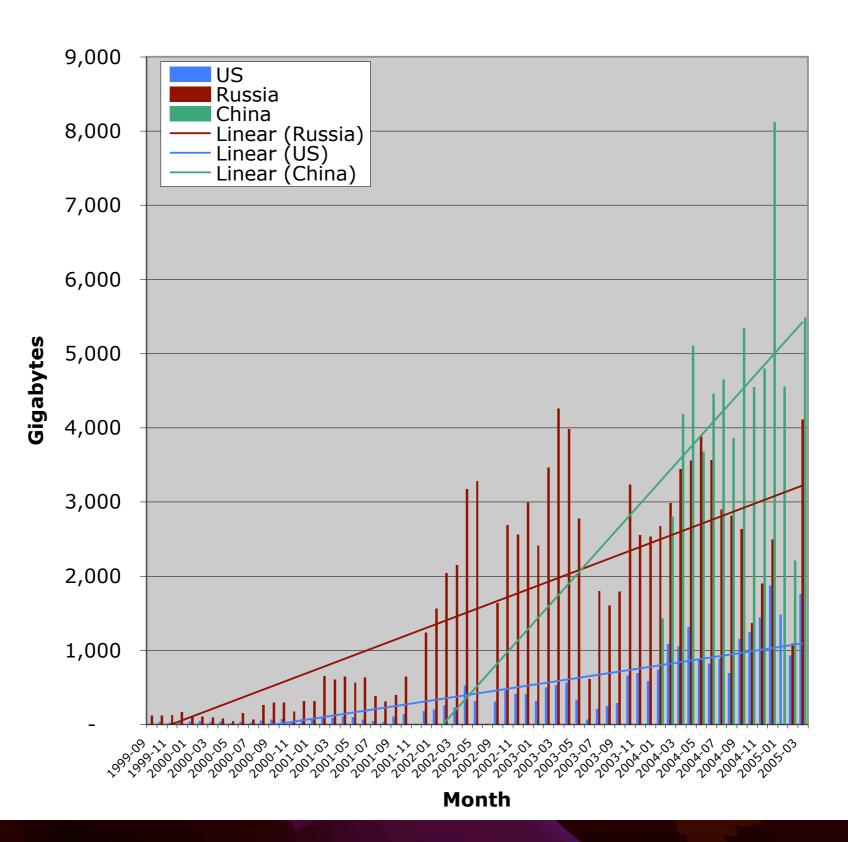
North America: CANARIE

Monitoring Program

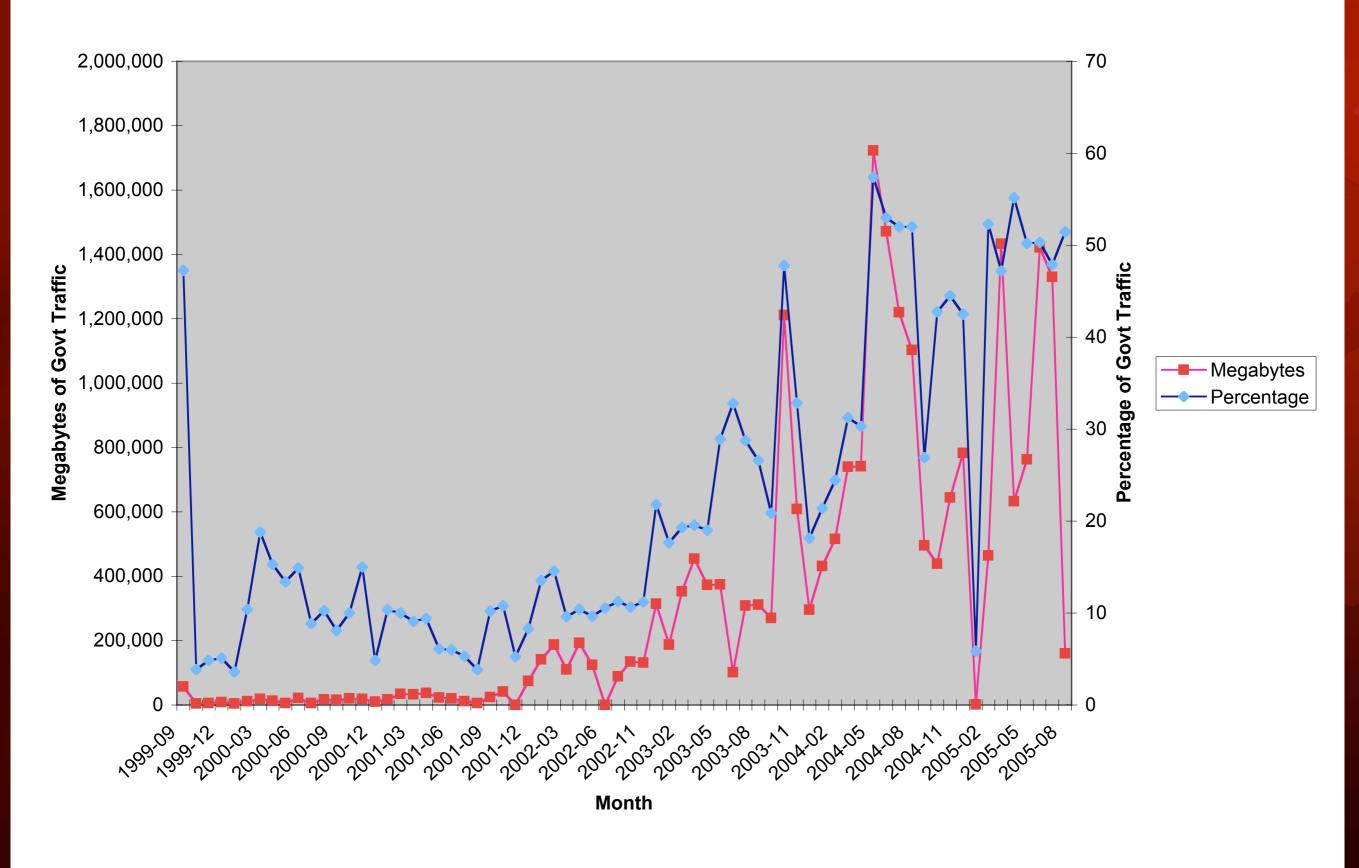
- Utilization Monitoring (netflow-based, circuit up-time, utilization, institutional and application reporting, MonALISA)
- Performance Monitoring (Intl AMP Mesh w/NLANR)
- Security Monitoring (BRO box in Chicago for research)

Overall Traffic Growth

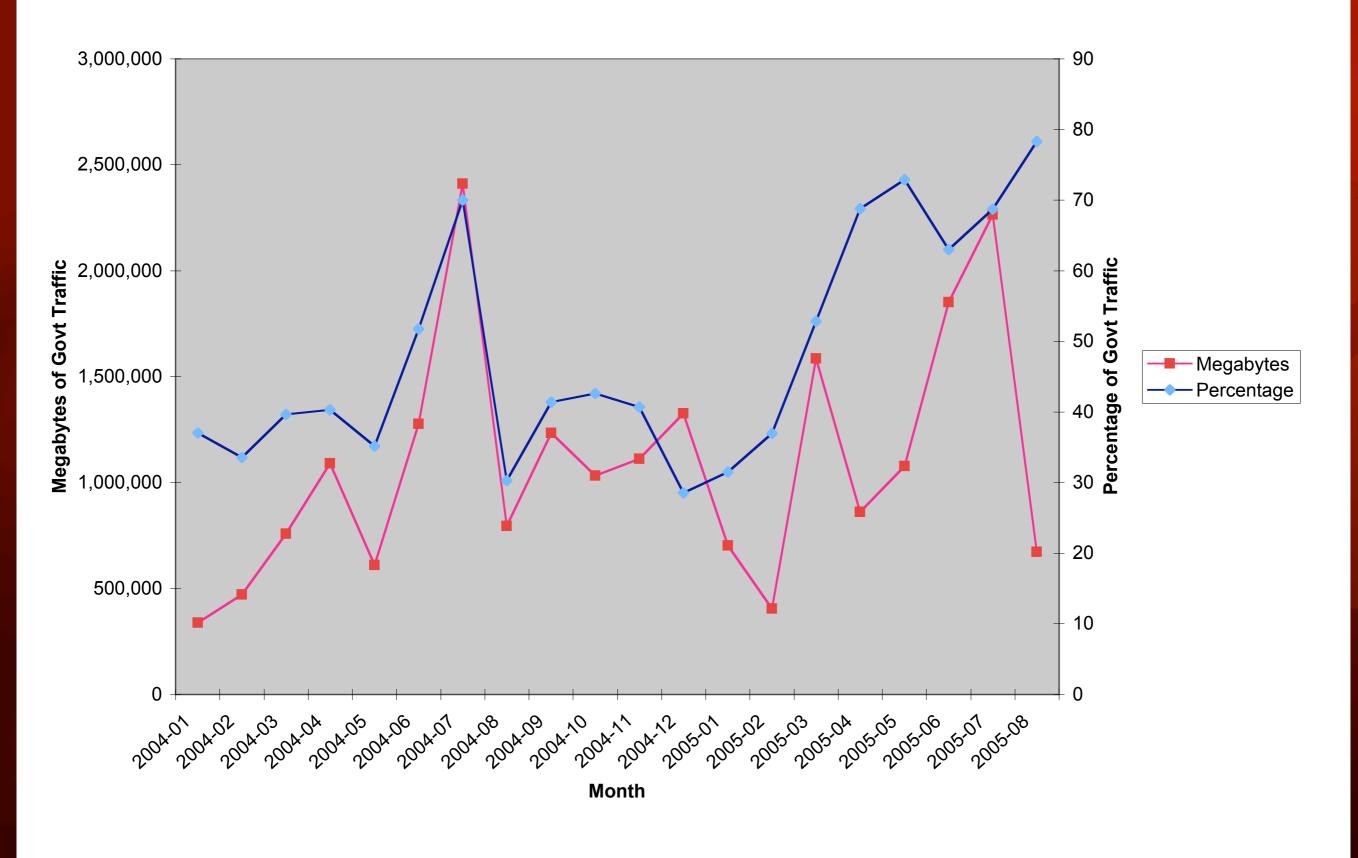
GLORIAD Data Flows



US to Russia Traffic



US to China Traffic



GLORIAD Top Users - Last 60 Minutes



Home GLORIAD Apps GLORIAD Team Management Operations

Monitoring System

Top Users
Graphs-24 hours
Graphs-30 days
Graphs-90 days
Top Users -10 Minutes
Top Users -60 Minutes
Top Users - 3 Hours
Top Users - 24 Hours

п

Top Applications
Throughput
Connection Speed
Efficiency
Retransmits
Round Trip Time

Sponsors GLORIAD Classroom Education Outreach Email Listservers Chat Room Search Tools

GLORIAD's sponsors

include the US National Science Foundation, a consortium of science organizations and Ministries in Russia, the Chinese Academy of Sciences.

Telecommunications services are provided by Tyco Global Networks, Inc. The monitoring system is designed to provide network utilization data related to usage of the GLORIAD network.

Current utilization of the GLORIAD link is illustrated below and updated every 60 minutes. The table lists the top 30 users of the GLORIAD network during the past 60 minutes.

Top GLORIAD Users Period: last hour (since 2005-08-30 08:49:24 (GMT))

Source Country	Source/Machine	Destination Country	¹ Destination/Machine	Protocol Meg	abytes	% Total
United States	NASA Engin for Complex Sys (ecs.nasa.gov)	China	Chinese Acad of Sciences (unknown) (159.226.110)	TCP- Other	3312.2	12.1
United States	NASA Engin for Complex Sys (ecs.nasa.gov)	China	Chinese Acad of Sciences (unknown) (159.226.110)	TCP- Other	1994.9	7.3
United States	UMD (umiacs.umd.edu)	Russia	Moscow State Univ (213.131.1)	TCP- FTP	1660.9	6.1
Russia	RU Space Science Internet (iki.rssi.ru)	Australia	edu. au (itd. uts. edu. au)	TCP- WWW	1379.1	5.0
United States	NASA Engin for Complex Sys (ecs.nasa.gov)	Russia	RU Space Science Internet (193.232.9)	TCP- Other	1358.7	5.0
China	Chinese Acad of Sciences (unknown) (213.131.2)	Thailand	ac.th (chula.ac.th)	TCP- WWW	539.7	2.0
United States	NASA Engin for Complex Sys (ecs.nasa.gov)	Russia	RU Space Science Internet (iki.rssi.ru)	TCP- Other	536.6	2.0
United States	NASA Engin for Complex Sys (ecs.nasa.gov)	Russia	RU Space Science Internet (iki.rssi.ru)	TCP- Other	454.0	1.7
China	China (unknown) (159.226.2)	United States	Carnegie Mellon (ul.cs.cmu.edu)	TCP- Other	410.6	1.5
United States	UCAR (scd.ucar.edu)	United States	United States (unknown) (210.77.88)	TCP- WWW	410.4	1.5
United States	US NOAA (cdc.noaa.gov)	Russia	sscc.ru (sscc.ru)	TCP- Other	405.9	1.5
Canada	Univ of Alberta	United	United States	ТСР-	392.8	1 4

Slideshow of GLORIAD Launch Ceremony

quicktimebased slideshow of the opening ceremony for the GLOR



for the GLORIAD network i available here.

More information about the launch ceremony is available.

GLORIAD Top Users - Last 24 hours



Home GLORIAD Apps GLORIAD Team Management Operations

Monitoring System

Top Users
Graphs-24 hours
Graphs-30 days
Graphs-90 days
Top Users -10 Minutes
Top Users -60 Minutes
Top Users - 3 Hours

Top Applications
Throughput
Connection Speed
Efficiency
Retransmits
Round Trip Time

Sponsors
GLORIAD Classroom
Education Outreach
Email Listservers
Chat Room
Search Tools

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Current utilization of the GLORIAD link is illustrated below and updated every 10 minutes. The table lists the top 30 users of the GLORIAD network during the past 24 hours.

Top GLORIAD Users Period: since yesterday (1 day) (since 2005-08-29 09:49:24 (GMT))

Source Country	Source/Machine	Destination Country	Destination/Machine	Protocol Mega	bytes .	% Total
United States	NASA Engin for Complex Sys (ecs.nasa.gov)	China	Chinese Acad of Sciences (unknown) (159.226.110)	TCP- Other	34953.0	5.8
United States	Fermi Natl Lab (fnal.gov)	Russia	RU Space Science Internet (193.232.212)	TCP- WWW	14638.1	2.4
United States	NASA Engin for Complex Sys (ecs.nasa.gov)	China	Chinese Acad of Sciences (unknown) (159.226.110)	TCP- Other	12616.1	2.1
United States	NASA Engin for Complex Sys (ecs.nasa.gov)	Russia	RU Space Science Internet (iki.rssi.ru)	TCP- Other	11620.0	1.9
China	China (unknown) (159.226.2)	United States	Carnegie Mellon (ul.cs.cmu.edu)	TCP- Other	9587.9	1.6
United States	UMD (umiacs.umd.edu)	Russia	Moscow State Univ (213.131.1)	TCP- FTP	7378.9	1.2
United States	UCB (colorado.edu)	China	Chinese Acad of Sciences (unknown) (210.77.68)	TCP- FTP	5165.2	0.9
United States	US NOAA (cdc.noaa.gov)	Russia	sscc.ru (sscc.ru)	TCP- Other	5059.1	0.8
United States	NASA Engin for Complex Sys (ecs.nasa.gov)	China	Chinese Acad of Sciences (unknown) (159.226.115)	TCP- Other	5025.4	0.8

Slideshow of GLORIAD Launch Ceremony

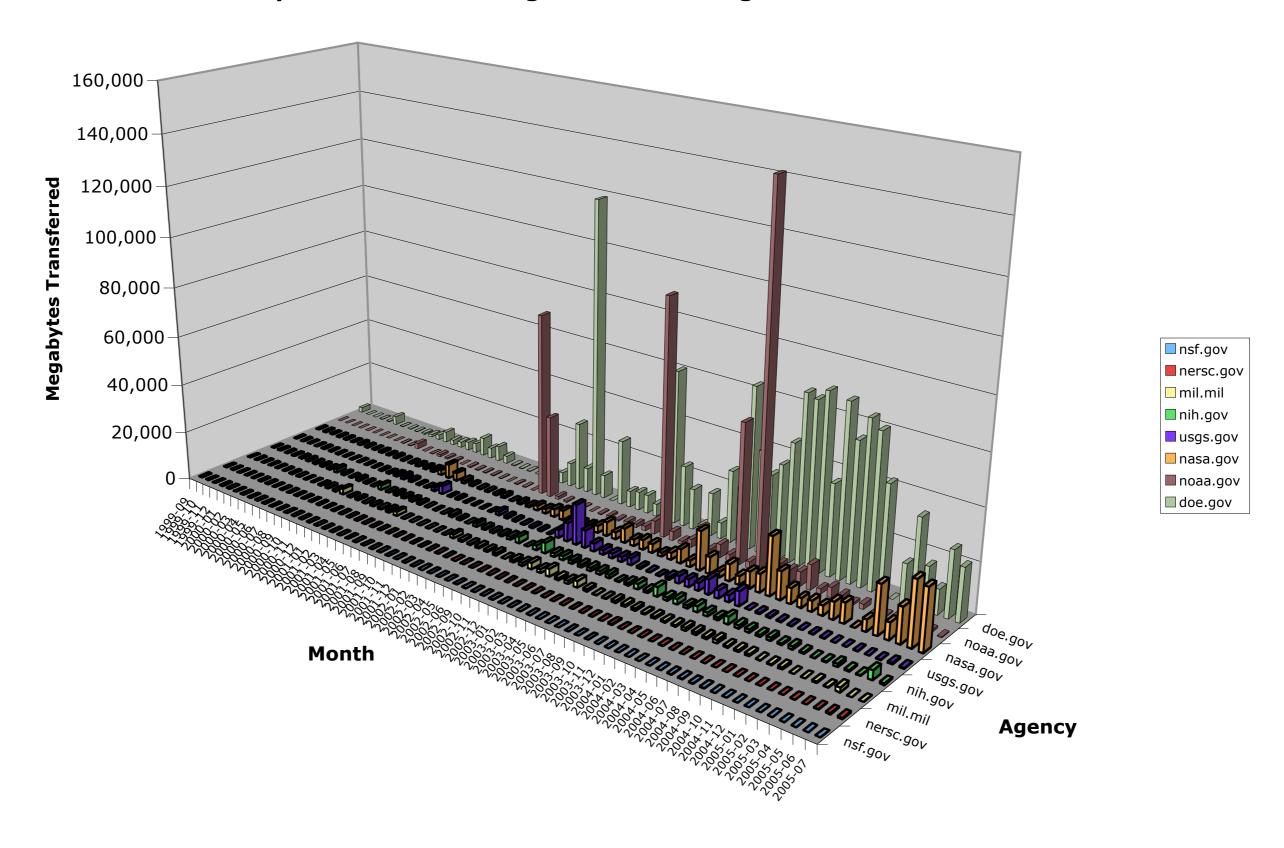
quicktimebased slideshow of the opening ceremony



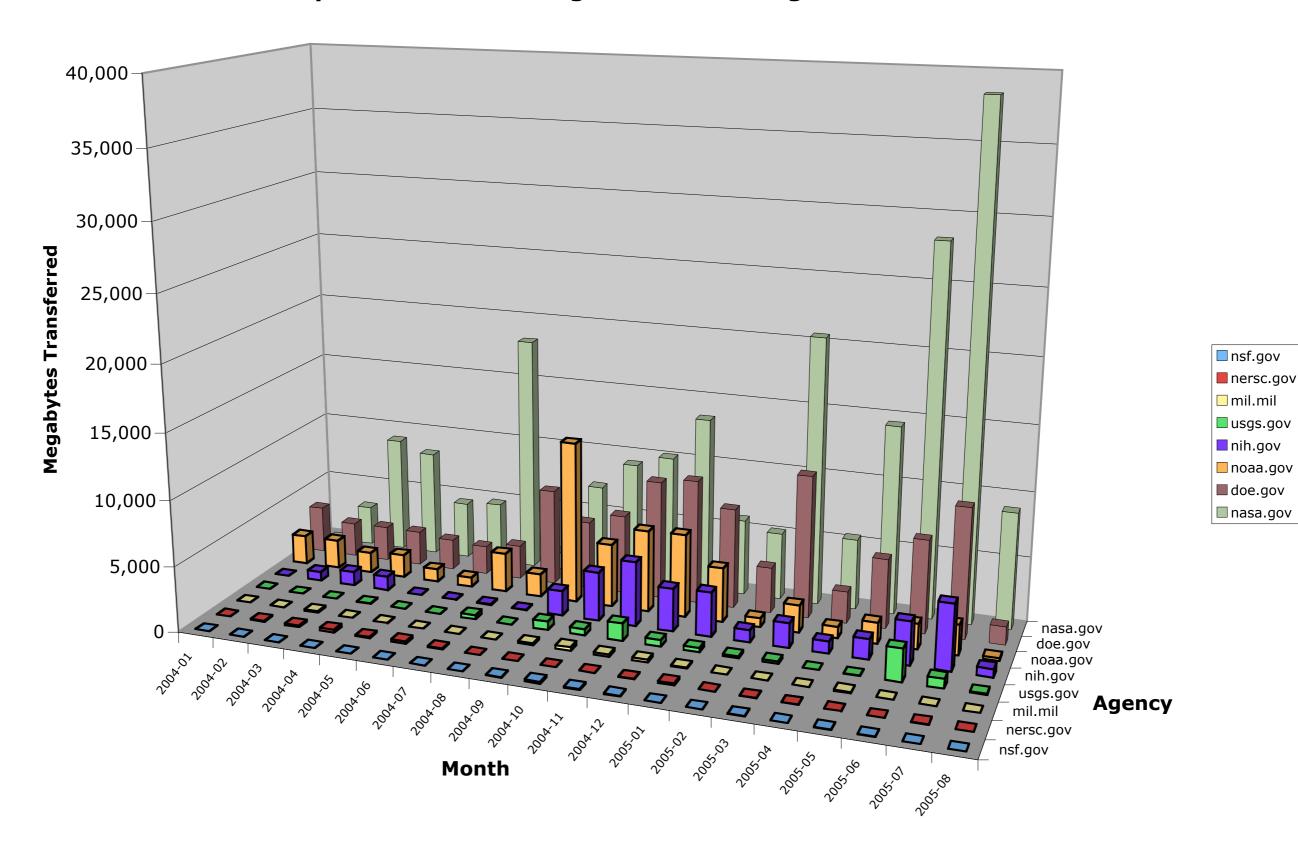
for the GLORIAD network is available here.

More information about the launch ceremony is available.

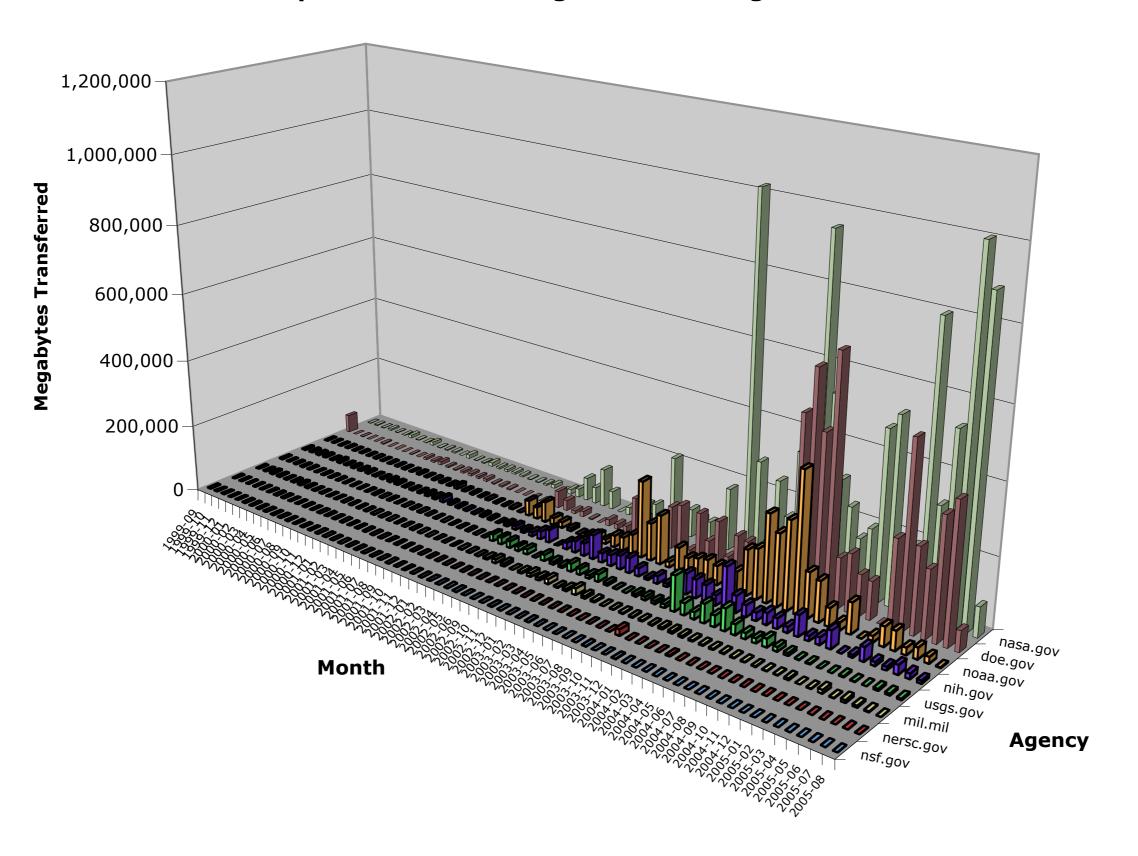
Top US Government Agencies Receiving Data from Russia



Top US Government Agencies Receiving Data from China

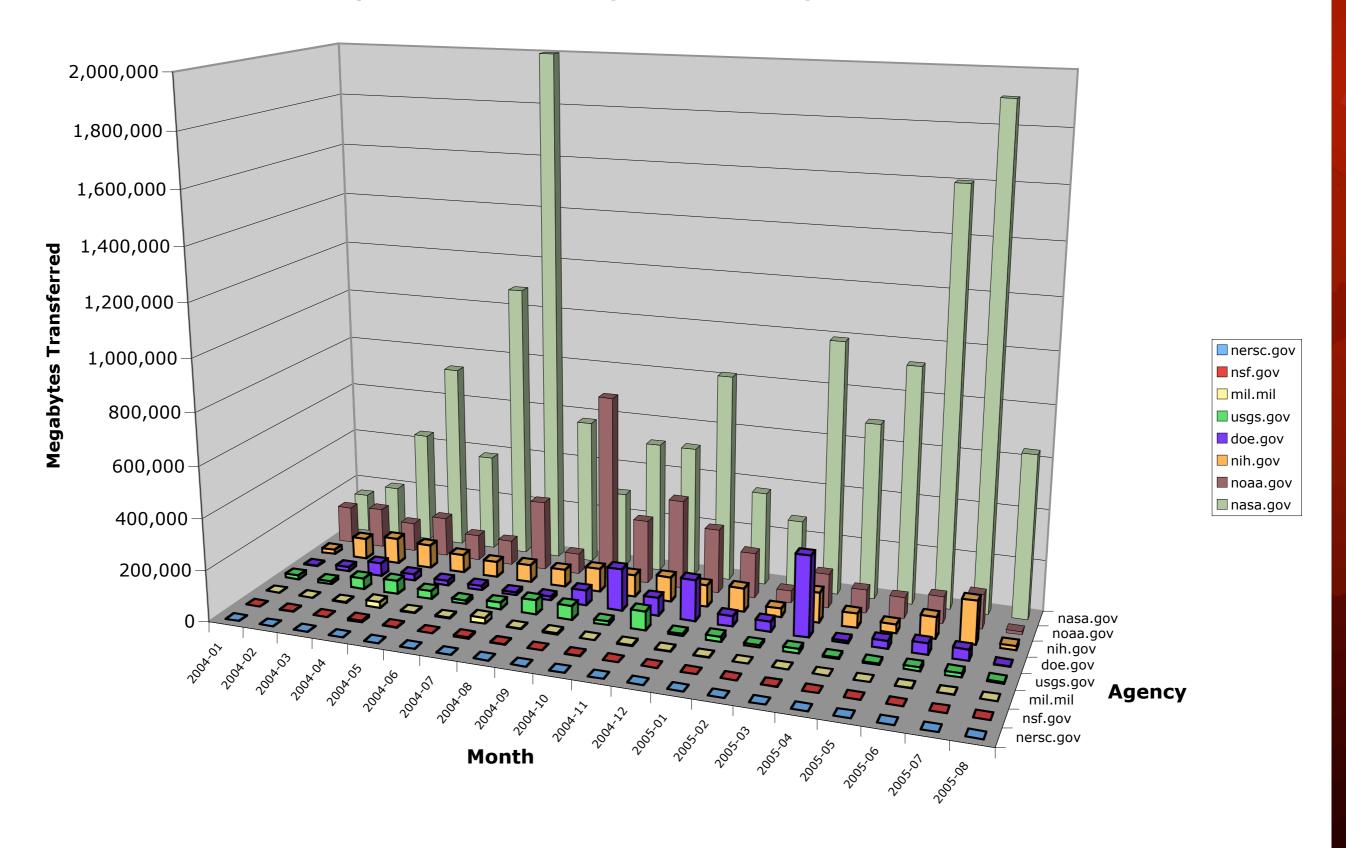


Top US Government Agencies Sending Data to Russia



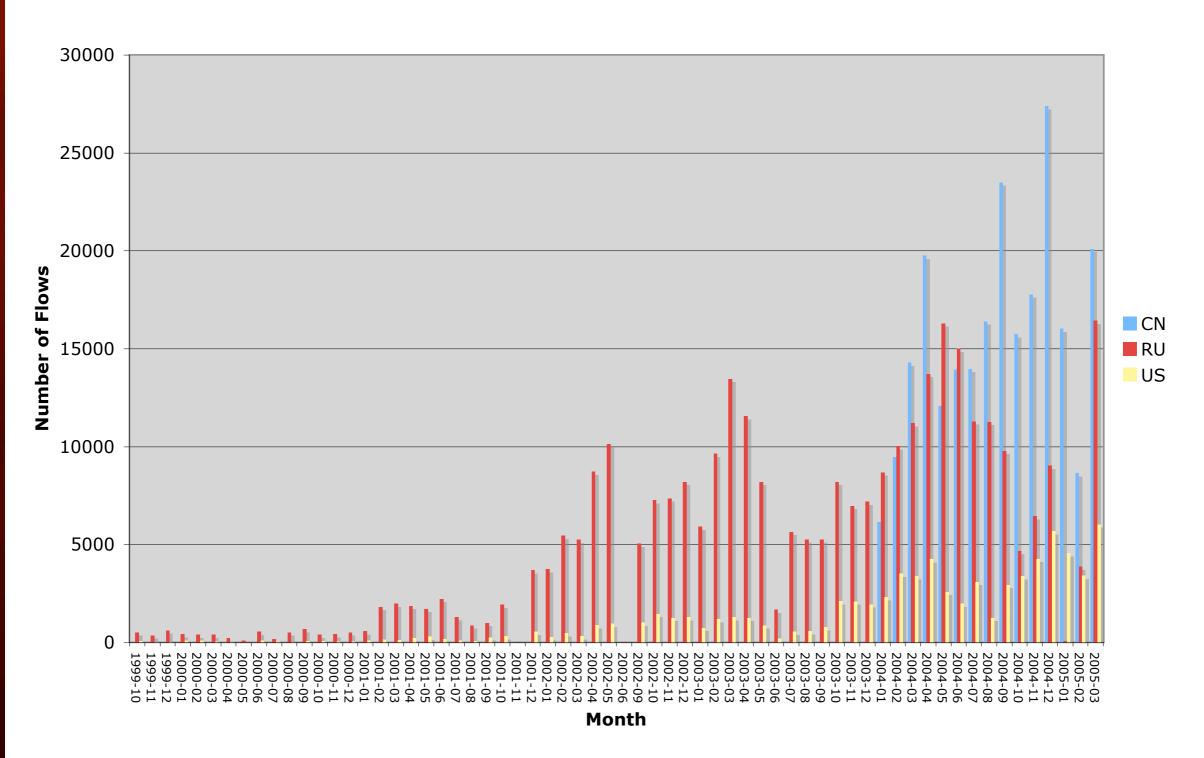


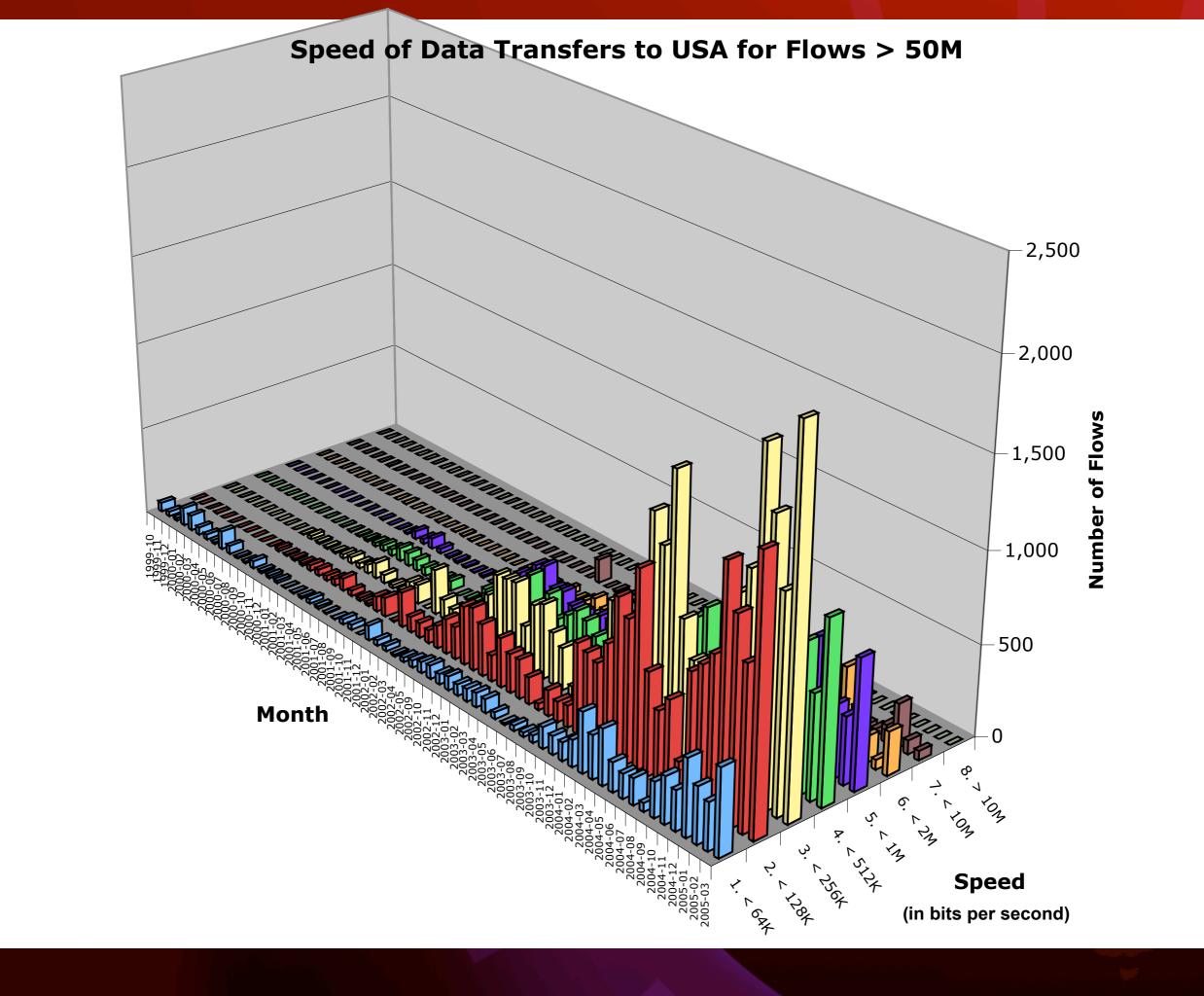
Top US Government Agencies Sending Data to China

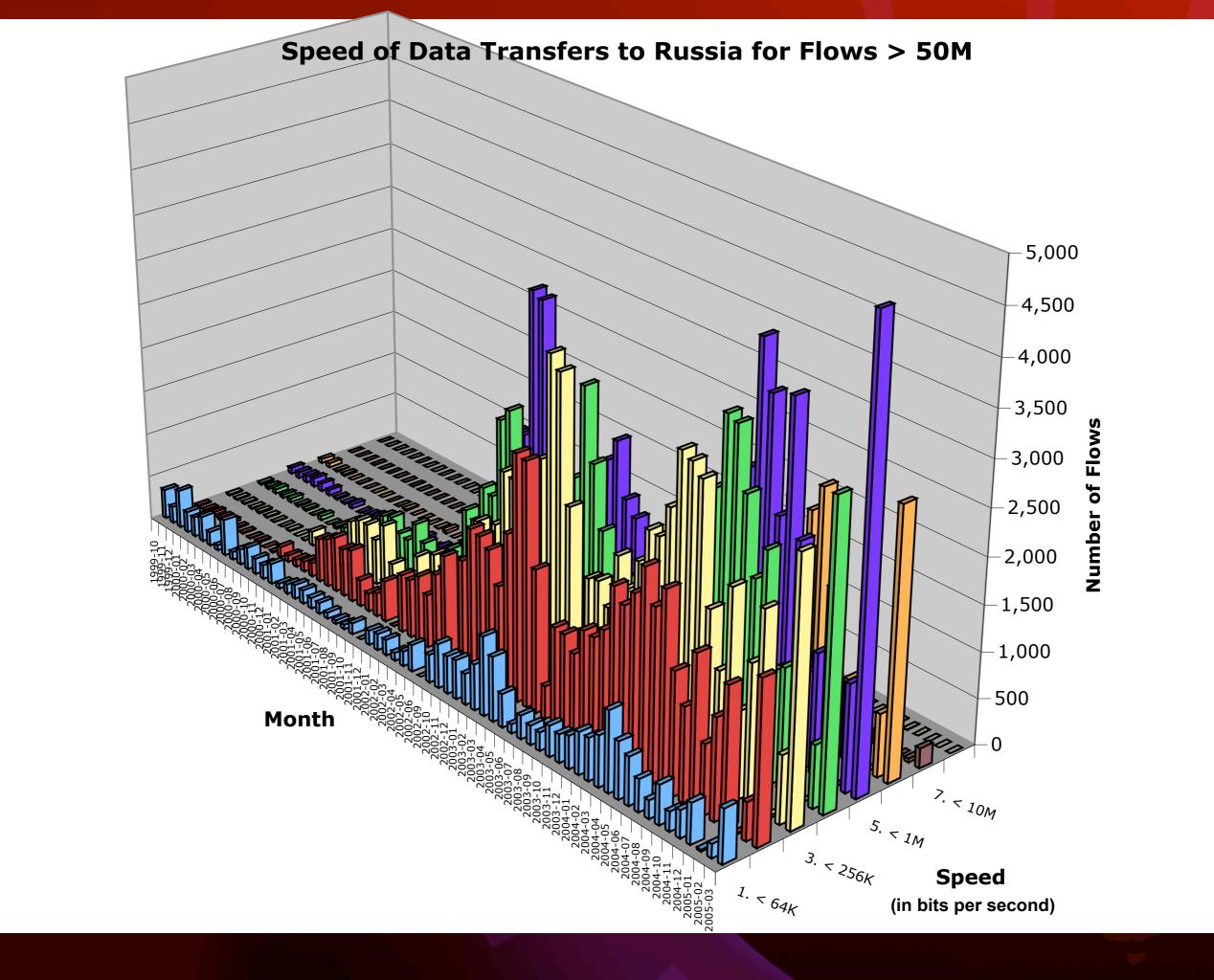


Growth in Data Flows > 50 Mbytes

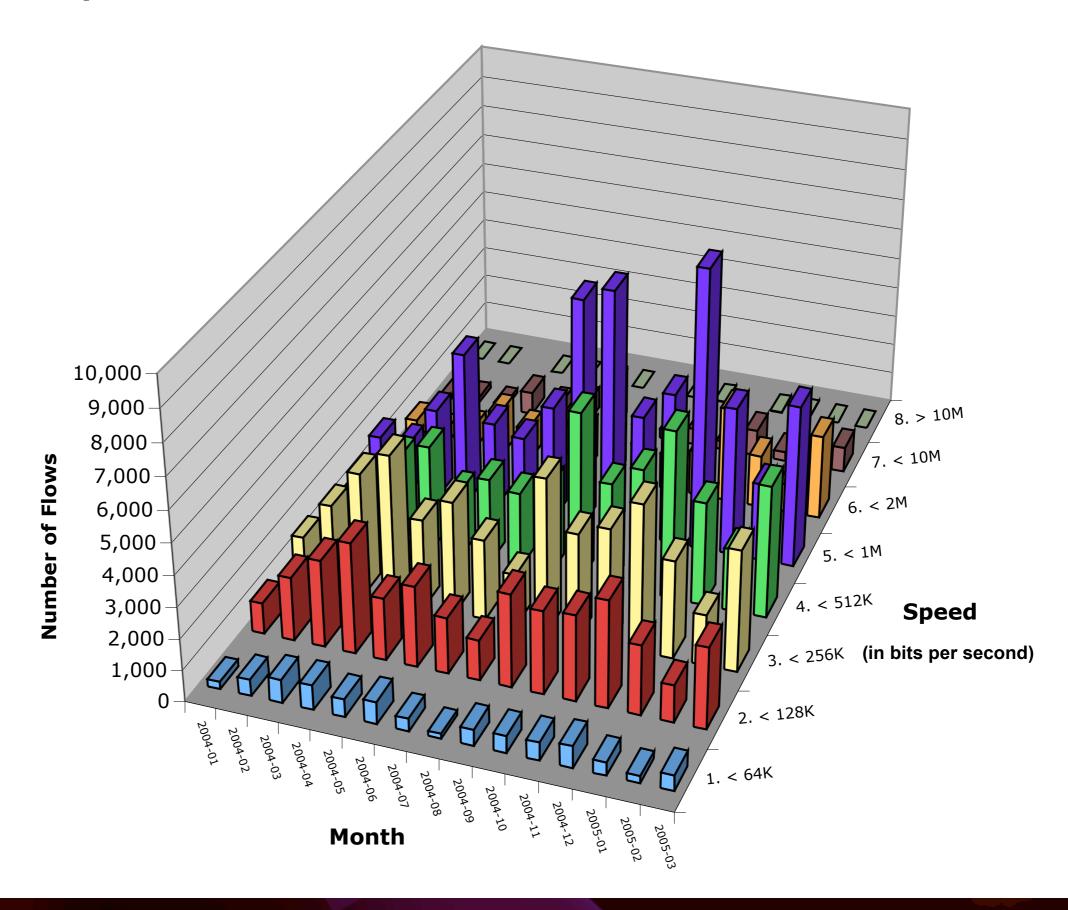




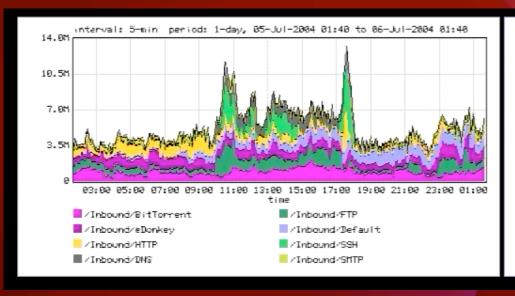


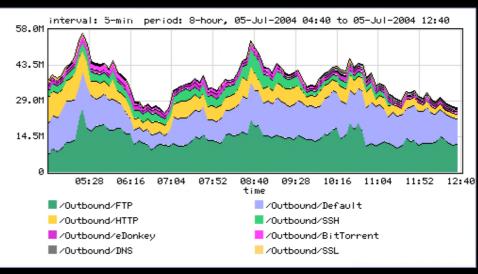


Speed of Data Transfers to China for Flows > 50M



GLORIAD Application Utilization Monitoring System (using Packeteer Boxes)







Institutional Use

Applications Use

Basic Performance metrics

Network "anomalies"

GLORIAD: network serving many needs



- Serving ITER, High Energy Physics, Astronomy, Atmos. Sciences, Earth Sciences, Bio Sciences, Telemedicine, Materials Sciences and many others
- Serving humanities and social sciences
- Serving Nuclear Non-Proliferation,
 Materials Protection, Anti-Terrorism,
 International Security
- Serving Educators: Edu-Cultural
 Digital TV Channel, Intl Science Fairs,
 Junior Achievement, "Simple Words",
 Virtual Museums
- Serving Advanced Networking: Wavelength Disk Drive, IPv6, Collaboration Infrastructure

Driving Disciplines

High Energy Physics Fusion Energy Physics/ITER Astronomy Earth Sciences ***Atmospheric Sciences/THORPEX GRIDS/Computational Resources Network Research

High Energy Physics

- Most immediate driver for international high performance S&E networking
- Large Hadron Collider (LHC) experiments will begin generating petabytes of data in 2007-2008, exabytes by 2015
- Community has developed international infrastructure for sharing data for shared analysis
- Heaviest single community user of GLORIAD today (40% of traffic some days)
- Propose need for GbEs immediately

High Energy Physics (HEP)

+ http://www.gloriad.org/gloriad/disciplines/hep/index.lsics (HEP)

Physics (HEP)

Home LORIAD Apps

pps by Country Canada China Korea Netherlands Russia USA

ps by Discipline
Energy Physics
In Energy/ITER
Spheric Science
Astronomy
Geosciences
dical Sciences
Network
s/Computing

IAD Team
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High Energy Physics (HEP)

The HEP community sets the pace for all in mapping out plans for handling enormous computational and data requirements – as we required network infrastructure. The <u>Large Hadron Collider (LHC)</u> example, more than 6,000 scientists and engineers from 250 univ and laboratories in 60 countries. These collaborators participate in experiments that will accumulate more than 10 petabytes each du 2007-08 and this will rise to the exabyte range by 2015, introducing unprecedented challenges in data access, distribution and collaborations.

The <u>Compact Muon Solenoid (CMS)</u>Compact Muon Solenoid (CMS) Collaboration at CERN provides another example where GLORIAD the need of cutting-edge science. Approximately 40 percent of the physicists at work on the CMS collaboration call the US, Russia or home. They, along with the 2,000 scientists involved in CMS will n high-capacity network to transmit results of these experiments.

Other non-LHC HEP experiments underway at Fermilab, SLAC and face similar challenges on a "smaller but still daunting scale." The communities are already heavy users of NaukaNet and GLORIAD and project the need for 300M/622M/1-2.5G capacity for major Hi centers in Russia, China and Korea in 2004/2005/2006 respective collaborators with HEP in Russia and China include universities and national laboratories throughout the US.

The following point to additional information about high energy ph applications:

<u>Description of High Energy Physics Applications in Russia(Projects progress)(High Energy Physics)</u>

Fusion Energy

International Thermonuclear Experimental Reactor

- GLORIAD motivated, in part, to help serve ITER community (US, Russia, China, Korea, Europe, Japan)
- \$Multi-billion construction to begin soon (site decision is made); #1 science/facility priority for US Department of Energy
- Will require GbE around GLORIAD ring initially; 10G circuit by 2008
- Heavy user of computational resources, need to cooperatively control experiments remotely, massive data storage and transmission requirements



GLORIAD/ITER-Grid Meeting, December 21, 2003

Astronomy

- International Virtual Observatory Project (involving US, Russia, China, Korea, Europe, others) proposes generation of 10 petabytes of data annually
- International Very Long Baseline
 Interferometry (VLBI) involves very high
 capacity network access to radio
 telescopes in Netherlands, US, Russia,
 China, Australia, elsewhere; network
 access to require multiple DWDM
 wavelengths



Home GLORIAD Apps

Apps by Country Canada China Korea Netherlands Russia USA

Apps by Discipline High Energy Physics Fusion Energy/ITER Atmospheric Science

Geosciences Medical Sciences Network Grids/Computing Others

GLORIAD Team
Management
Operations
onitoring System
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earch Tools

Astronomy

Progress in astronomical research requires access to all t astronomical data, since insight comes from correlating d different wavelengths and with different techniques, and of the observational results with astrophysical simulations.

Problems in making this vision a reality include lack of sufbandwidth and the inhomogeneity of the data and the and access methods.

The <u>International Virtual Observatory</u> project, scheduled a 2008, will produce 10 petabytes of data per year, yet the on networks such as GLORIAD to solve the issue of bands transmit enormous sums of data. GLORIAD will enable US access IVO data resources in Russia and China and vice-will enable real-time very long baseline interferometry be Long Baseline Array in the U.S. and radio telescopes in the Russia, China, and Korea.

The <u>International Square Kilometer Ray Consortium</u> will r to provide network services for baseline interferometry b Long Baseline Array (VLBA) with partner countries, and a the distributed SKA paradigm.

KOREA: Korean Virtual Observatory Project

The virtual observatory projects are being develop national levels at about 15 countries including Kore Virtual Observatory (KVO, http://kvo.kao.re.kr) we February 2003 by astronomers in Korea Astronomiand some universities.

Earth Sciences

- US, Russia, China, Canada together comprise large percentage of earth's surface and already have large domestic infrastructure for sensing seismic activity, atmospheric conditions, environmental conditions, satellite-based imagery coverage, etc.
- GLORIAD proposes to ensure higher capacity/easier data sharing between major earth science initiatives seismic monitoring, satellite imagery, environmental monitoring, forestry/wildfire studies, etc.
- Special emphasis in GLORIAD on extending access to Central Asia generally and to the Bishkek Geologic Proving Ground specifically

Deformation Field over Bishkek Proving G...GPS<i>(Project

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🕙 http://www.gloriad.org/gloriad/projects/ru/projec

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Deformation Field over Bishkek Proving Ground Develor o start)(GeoScience)

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2D and 3D Deformation Field over Bishkek Proving Grou Base of the GPS Data. Manifestation of the Deformation Resistivity Variation Pattern (*Project proposed to start*)

Organization who response for the project from Russian Station, RAS; The Geophysical Center, RAS **Principal Inves** Prof.A.M.Fridman, prof. G.A.Sobolev, prof. V.A.Zeigarnik

Organization who response for the project from US side of Technology

Principal Investigators (USA): Prof. Bradford Hager, Prof.

Description The Bishkek Proving Ground (BPG), the Resear Sci. has been developing since 1982.



Atmospheric Sciences

- Programs include general atmospheric modeling, climate change studies, weather prediction, etc.
- Data transmission requirements requiring GbE+ (also enormous shared computational and data storage)
- Special emphasis on International THORPEX program established in 2003 as a 10-year global atmospheric R&D program emphasis on mitigating effects of natural weather-related phenomena by providing much more accurate 1-14 day forecasts.

THORpex <i>(Project in progress)(Atmospheric Science)



🕙 http://www.gloriad.org/gloriad/projects/ru/project20040

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ct in progress)(Atmospheric Science)



Home AD Apps

y Country Canada China Korea therlands Russia USA

Discipline
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Sciences
Network
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Others

Team ment ions em THe Observing-system Research and predictability experiment

HORpex



1.General description

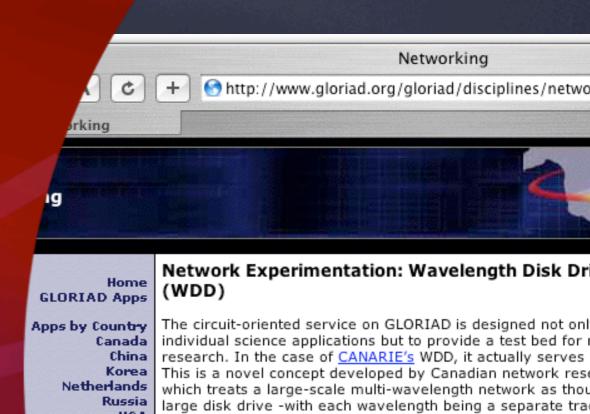
A Global Atmospheric Research Programme THORPEX is a ten-year international research programme, under the auspices of the Comm of the Atmospheric Science, and its World Weather Research Progra (WWRP). The purpose of THORPEX is to accelerate improvements in short-range (up to 3 days), medium-range (3 to 7 days) and extend range (week-two) weather predictions and the social value of advantage forecast products. THORPEX would examine global-to-regional influence on the predictability of high-impact weather and establish the potent produce significant statistically-verifiable improvements in forecasts those time scales.

2. Scientific background

The success of numerical weather prediction represents one of the rignificant scientific, technological and societal achievements of the century. Despite the notable increase in forecast skill over the past quarter century (Fig.1), there is a necessity for further improvement particularly, in high-impact weather forecasts and in the use of weather formation. High-impact weather forecasts are defined by their effectively and the economy. They are typically associated with forecasts

Network Research

- With its hybrid architecture,
 GLORIAD will provide an
 experimental "sandbox" for network
 researchers enabling
 experimentation without putting
 production services at risk
- Canadian Wavelength Disk Drive (WDD) treating a service across the GLORIAD ring as a "disk drive" circulating data around the earth with "readers" and "writers" at various locations useful for data needed by international parties at approximately the same time
- Another is the Canadian User Controlled Lightpath (UCLP)



The circuit-oriented service on GLORIAD is designed not onl individual science applications but to provide a test bed for i research. In the case of CANARIE's WDD, it actually serves This is a novel concept developed by Canadian network rese which treats a large-scale multi-wavelength network as thou large disk drive -with each wavelength being a separate tradevices on the network (running the WDD software) acting a heads. The hard/software injects a data record into the nety flow. When the next WDD node receives a packet it is forwa next node, resulting in packets continuously circulating arou network. CANARIE and GLORIAD will test capability of the quantum control of the quantum capability of the quantum capabili GLORIAD network to prove the concept in the ring around the hemisphere - while much less capacity, it is a longer path the given unit capacity to carry more data. There are application from Russia for using the WDD to enable global monitoring of and time-critical data streams.

Apps by Country
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Korea
Netherlands
Russia
USA

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Other Areas of Collaboration

Grids and Shared use of **Computational Resources**

Network Security

Materials Science (ORNL's SNS)

Bioinformatics/Bioengineering

Telemedicine (US-Russia effort in cancer research)

Nuclear Materials Protection and Non-proliferation programs

Emergency Response

Joint Anti-terrorism Programs

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GLORIAD Classro **Education Outreach**

clude the US Nationa cience Foundation, a roanizations and nistries in Russia and th hinese Academy of

of the University Illinois at Urbana-

of the most complicated situations, exchange with statistical data regarding the procedure and results of the most important and complicated procedures and operations. In order to reach the above mentioned aims it is necessary to have a possibility to hold on-line tele and video-conferences, to exchange with electronic records of patients, with medical diagnosis images (X-ray, ultra sound examinations, and comography) and angiographic films. The strictest measures should be undertaken in the INIS to guarantee confidentiality of medical information n order to prevent unauthorized access to the servers of medical nstitutions. Creation of IMIS will be exclusively beneficial for all the participants of this project. IMIS will make it possible to disperse experience in health care, the latest achievements in medical nstrumentation, methods of diagnosis and treatment of the most complicated diseases

n Russian Federation there has been created a hard-and-software complex DIMOL by the developers of the Russian research Center 'Kurchatov Institute" in cooperation with the Scientific and Practical center of Intervening Cardiology. The DIMOL complex is intended for automation of medical procedure processes in cardiological clinics. Such complex has been working during more than five years at the Scientific and Practical center of Intervening Cardiology in Moscow

Fig.1. Author of the project DIMOL.From left to ight: Gnedenko V.G., faineberg E.M.,Iosselian

Cardiology is one of the main and most rapidly developing directions of treating cardio-vascular diseases. The methods of ntervening cardioangiology are intended for mass implementation; they are distinguished for being low traumatizing, provide patients to ecover during minimum possible period of ime. The positive results obtained and the nigh capacity of the method are caused mostly by the degree of its automation and computerization. The DIMOL complex provide practically full automation of this process, reduce the time required to make right



Other Applications

GLORIAD Apps

Other science disciplines supported by the GLORIAD network include: nuclear materials protection and materials accounting and control, next generation optical network research and design, use of the ORNI-sited Spallation Neutron Source, nanomaterials, bioinformatics, bioengineering. telemedical applications, and various educational programs.



Education & Outreach

- Central Asian and Western Eurasian networking extension
- Big Interest re: connectivity to India and Pakistan
- GLORIAD Classroom
- **EduCultural Channel**
- Collaboration Infrastructure (IP Telephony Network (using Cisco donation) and HEP/VRVS)
- "Simple Words" Essay Program
- "Junior Achievement" Partnership
- Virtual Science Museum of China
- "Great Wall" Society Programs
- **Electronic Cultural Atlas Initiative**

Year 1 Plans

- **Grand Opening Ceremony, New Operating Agreement**
- Complete Architectural Plans, Landing Sites/Equipment Deployment, New Circuits (Amsterdam, Moscow, Hong Kong, Busan)
- Governance Structure, Working Groups Operational
- **GLORIAD Classroom**
- **EduCultural Channel**
- Collaboration Infrastructure Deployed (IP Telephony, VRVS Reflectors)
- BRO Box deployed, integrated with router
- New Monitoring System (using Packeteer/Netflow product)
- New Web Site
- "Simple Words" Pilot in US

This is all made possible by ...

- NSF (6+ years of support) and our sponsors in Russia, China, Korea (and others)
- Our partners in Russia, China, Korea, Netherlands, Canada, throughout the GLIF
- US partners UT/ORNL (Homer Fisher, Bill Snyder), NCSA, UT/ORNL (again), Jim Olson, Mike Rieger, Bill Marra (Tyco), Starlight partners: Tom, Joe, Maxine; IRNC partners, Harvey Newman, Steve Goldstein, Tom Greene, Aubrey Bush, Yves Poppes, partners at US govt agencies (and many, many others)
- Email, the Internet, Trans-oceanic/contintental circuits, "Friends and Partners"

Global Ring Network for Advanced Applications Development (GLORIAD)

ONT2 Workshop September 13, 2005

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Animation by Chinese Academy of Sciences Computer Network Information Center



http://www.gloriad.org/

VSNL